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SOFT FUNCTIONAL SILICONE ELASTOMERS WITH HIGH DIELECTRIC PERMITTIVITY: SIMPLE ADDITIVES VS. CROSS-LINKED SYNTHESIZED COPOLYMERS

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Though dielectric elastomers (DEs) have many favorable properties, the issue of high driving voltages limits the commercial viability of the technology. Improved actuation at lower voltages can be obtained by decreasing the Young's modulus and/or decreasing the dielectric permittivity of the elastomer. A decrease in Young's modulus, however, is often accompanied by the loss of mechanical stability and thereby the lifetime of the DE whereas addition of high permittivity fillers such as metal oxides often increases Young's modulus such that improved actuation is not accomplished. New soft silicone elastomers with high dielectric permittivity were prepared through the use of chloropropyl-functional silicones. One method was through the synthesis of modular cross-linkable chloropropyl-functional copolymers that allow for a high degree of chemical freedom such that a tuneable silicone elastomer system is obtained. This system provides high dielectric permittivity without compromising other important properties of DEs such as viscous and dielectric losses as well as electrical breakdown strength. Another method was through a one-pot system where functional silicone copolymers are added as an additive to commercial silicone elastomer systems. Here the functional copolymer acts both as a permittivity enhancer and plasticizer. We show how the DE properties and the dielectric permittivity to Young's modulus ratio are improved for these systems and we compare the use of cross-linkable polymers against the use of plasticizers with similar chemical structures on the final mechanical stability and lifetime of DEs.